



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

AMERICAN STATISTICAL ASSOCIATION.

NEW SERIES, Nos. 35, 36.

SEPT.-DEC., 1896.

ROUND NUMBERS IN WAGES AND PRICES.

BY EDWARD D. JONES, PH. D.,

UNIVERSITY OF WISCONSIN, MADISON, WIS.

It is of great though of usually unrecognized importance that the measures of distance, area, time, value, weight, and bulk used by a people should strike, in their combination and use, a proper balance between convenience on the one hand and accuracy on the other. The importance of the size and groupings of the units in which wages and prices are expressed becomes apparent as we consider the imperfect nature of most of our measurements and the consequently important part played by estimates. If estimates can be shown to be freely used in determining wages and prices, any peculiarities that may be exhibited by them will certainly be important. On the other hand, if we know the peculiarities of estimates we can by those signs discover them and determine their frequency. The aim of this paper is to point out some of the peculiarities of estimates, especially to consider their relation to convenient or usual quantities or to the so-called round numbers. Paul Leroy-Beaulieu, having in mind the peculiarities of retail trade, says, on the subject of the monetary unit: —

"We believe that the smallness of the monetary unit has no influence whatever upon wholesale prices of goods, but that it has, on the contrary, an influence upon the remuneration in certain professions, and upon many current household expenses. It seems to us certain that here, in France, if the unit fixed were the shilling (1fr. 25c.), instead of the franc, in most cases where one now pays a franc, such as entrance to a theatre and other amusements, it would as a shilling rise to 1fr. 25c. In the same way the penny is worth a little more than 2 sous (10 centimes): it is therefore clear that if the penny were the division of money adopted in France, you would always have to give a penny where you used to give two sous. It would be the same in the payments of the liberal professions. The louis d'or, or napoleon of 20 francs, is the usual fee for a visit to a consulting physician or a barrister. If the gold coin of 25 francs were adopted in France, we may be sure that at the end of a very short time it would in all cases be substituted for the louis or napoleon, and thus the coin of 12fr. 50c. would have taken the place of that containing 10fr. . . . In wholesale prices competition acts with almost mathematical precision, but in retail prices, in amusements, in the fees of many professions, where the ordinary divisions of small change are adhered to, there is a sort of routine established which would be found very difficult to change." *

The tendency toward round numbers is toward the economy of an easily remembered and easily handled number in which to sum up a complete transaction. It shows itself particularly where the amount is small and accuracy is not insisted upon. The tendency is most powerful among those classes of people who are not accustomed to accurate thinking, especially in mathematical calculations. A desire to minimize a given set of facts sometimes results in clinging to round numbers which long have ceased to be even approximately representative. This appears most clearly in statistics of age. An illustration of this may be seen in the following figures taken from the *Report of the Illinois Bureau of Labor* for 1892, pages 300, 301. The columns below give the ages reported by women engaged in industry in Chicago. The total number reporting is 3467.

* *Bankers' Magazine*, London. Vol. 41, pp. 828, 829.

| | | | | | |
|---------------------------|------------|---------------------|------------|--------------------------|-----------|
| Under 14 years, | 10 | 22 years, | 201 | 31 years, | 17 |
| 14 years, | 73 | 23 " | 208 | 32 " | 19 |
| 15 " | 177 | 24 " | 139 | 33 " | 13 |
| 16 " | 280 | 25 " | 135 | 34 " | 11 |
| 17 " | 339 | 26 " | 96 | 35 " | 21 |
| 18 " | 401 | 27 " | 66 | 36 " | 12 |
| 19 " | 335 | 28 " | 50 | 37 " | 6 |
| 20 " | 356 | 29 " | 25 | 38 " | 7 |
| 21 " | 282 | 30 " | 69 | Over 38 years, | 59 |

The round-numbered estimate is indicative of several things. It marks a compromise for practical purposes when an exact determination of the quantities involved is difficult or impossible. Thus a professor is paid \$1500 because no one is presumptuous enough to say that he can determine that a professor's services to society are worth \$7.00 or \$57 more or less than this. But we need not resort to purely intellectual services. No builder of a house can so closely estimate the cost of a structure, the length of time it will endure, the probable increase or decrease in the value of a location, and the variation of the rate of interest, that he is in a position to say that a house ought to rent for 50 cents more or less than a given sum per month. Again, estimates may indicate a poor memory, lack of attention to details, the absence of a definite unit of measure from the mind, due to imperfect education, etc. Our schools disdain to show a boy how long a rod looks, how heavy a pound feels in the hand, how large an acre is, to say nothing of how valuable a dollar is to the majority of men.

The use of round numbers in values sometimes indicates disdain for careful calculation. Bets and braggadocio, as well as ignorance and sloth, run to round numbers. The admiration of the American for large businesses, for large expenditures, for large undertakings of every sort, works a serious evil when the American mind mistakes exactness for penuriousness. As a rule Americans greatly overpay little services. The fact that a gratuity of less than 25 cents in some sections

is thought contemptible, may in the future form the basis of a most extortionate system, should the parvenu be as effective as he has been in the recent past in dragging the tipping system into a country where an open contract for wages has always been the rule between employer and employed. Round numbers frequently locate for us those fields in which propriety dictates that economic motives, which prompt to exact measurements of value, shall be made subordinate to other considerations.

Estimates indicate uncertainty. They are met most frequently in the statement of what is mere opinion. They sometimes are and sometimes are not involved as determinative economic factors. The chief importance of this distinction is that, as a given set of facts develop into economic significance, greater care is taken in their calculation and round numbers give way to more exact expressions. Measurement excels the estimate in accuracy within the lines in which it operates; it falls below it for practical business in so much as it lacks comprehensiveness. The safest business methods combine measurement and estimate.

Customary groupings of units of measure take place chiefly on the multiples of five, and, in dealing with large numbers, multiples of ten, one hundred, etc. The use of multiples of two shows itself in a less degree and in small numbers only. There are certain groupings retained by custom, and accountable on other grounds than economy, such as the dozen, stone, yard, etc. There are also a number of indefinite units of measure retained in almost constant use, because their very lack of accuracy accommodates the indefiniteness of our ordinary concepts. Examples of these are: For distance, "a stone's throw;" for time, "a jiffy" and "a coon's age." It is perhaps significant of greater accuracy in the measurement of value that for it such indefinite expressions are little used.

Although estimates are distinguished by the use of round numbers, all computations which include an estimated com-

ponent factor do not show the round numbers. When an estimated factor is multiplied into one which is the result of accurate measurement, the round numbers, of course, disappear. Resultants expressed in exact figures, but which include estimated component factors, are presumptions so far as the digits affected by the embodied estimates are concerned. Estimates appear in economic transactions wherever the ignorant and unskillful are a party. They also characterize attempts to put a money valuation upon intellectual and moral forces. Estimates, therefore, appear in retail rather than in wholesale trade, and characterize salaries.

If we were to attempt to determine the wages likely to be offered to an individual, in a given case, we should probably be conscious that we were determining the resultant of a large number of contributory influences. We should be called upon to consider the length of time for which services were to be paid, the intervals between stretches of work, the quality of the service rendered, the conditions of the market as these are usually understood, standard of life, etc.

The study of estimates goes to show that to the considerations above enumerated we should add that wages are modified by the size and groupings of the units in which work-time is measured, as hours, days, weeks or months; also by the money units in which payments are made, and their groupings into dimes, quarters, and dollars. Furthermore, we should know the usual classes into which workmen are divided. The class of considerations last mentioned may not, in any individual case, be as important as those previously enumerated, but it seems probable that they are more constant and all-pervasive. To take up, then, these various measurements in the most natural order, let us examine as to the length of the period of labor employed as the unit for reckoning payment. The value of a man's services to an employer can usually be fixed within certain limits only. An upper and a lower figure can be placed with considerable certainty. In the bargaining of the market the employer

says, "Your services are not worth over so much." The other says, "They are worth at least so much." The personal equation and the intrenched economic position of the parties determine at what point between this maximum and minimum the bargain will be concluded. For certain services the yearly value can be more closely estimated than the daily or monthly. For other services the opposite is true. A number of time-units may be employed in paying wages. Carpenters are paid in Wisconsin by the hour, the day, the week, the month, the year, and the job, with and without board. Between these various methods of payment discrepancies exist, which in part arise from a desire to express in convenient round numbers the wages of the labor-time which has been chosen as the unit of payment. When there are in use various ways of paying labor, comparisons become difficult. The statisticians are not the only ones who are inconvenienced by this fact, for because of this confusion of method the wage-earning classes can form a less clear and complete idea of the prevailing wage levels than would otherwise be possible. The terms of their employment thus become the subject of special agreements made each time with the employer. The workman is at somewhat the same disadvantage as is the buyer of a fine painting or rare piece of bric-a-brac, in comparison with one who buys a definite quantity of a well-known brand of canned beef, or canned fruit, or thread. Thus it sometimes happens that persons who desire to underpay their employees adopt an unusual method of payment in order to make comparisons with the wages of other employers more difficult.

The difficulty that confronts labor bureaus, and the confusion of the labor market arising from various methods of payment, can well be illustrated from the statistics of Wisconsin. In answer to inquiries directed to various Wisconsin employers by the State Bureau of Labor in 1893, the fact was brought out that third-year carpenters of pretty even grade were paid at the rate of \$30 per month, \$200 per year,

\$1.50 per day, 20 cents per hour, and \$12 per week. If we were to calculate yearly wages these rates would be, respectively, \$360, \$200, \$465, \$558, and \$624; or, counting employment for the half-year only, except in the case of a yearly wage, the rates would be \$180, \$200, \$232.50, \$279, and \$312.

The use of round numbers shows itself again in a working day of eight and ten hours, rather than one a quarter or a half hour longer or shorter, such as would undoubtedly have been used had it so happened that an hour was 55 or 65 minutes, instead of 60.

The inaccuracies of time estimation are, however, unimportant in comparison with those in the estimation of talent. There is a rough concept in the minds of employers of what is called a "three-dollar-a-day" man, a "two-dollar-a-day" man, a "one-dollar-a-day" man, and a "boy;" but even for the most mechanical labor the discrimination is seldom closer than two and a half cents per hour, a quarter of a dollar per day, five dollars per month, etc. On the streets and in the harvest fields one often sees a group of men paid at the same rate, but bearing a very different proportion of the "burden and heat of the day."

The larger the element of skill involved in labor, and the more the intellectual factors decide the success or failure of an exertion, the more difficult it becomes to fix exactly the compensation due for a certain service. Hence salaries are in part distinguished from wages by the greater frequency of estimates and consequently the greater use made of round numbers. Let us illustrate the difference between wages and salaries by two parallel columns, one taken from the United States Treasurer's estimates of expenditures, giving government salaries and arranged consecutively according to amount; the other taken from the *Report of the Maine Bureau of Labor* for 1891. The latter gives the wages of shoemakers, and we have chosen, in order of their amounts, the highest 15 out of 136.

| SALARIES.* | | WAGES.† | |
|----------------------------------|---------|------------------------|-------|
| President's private secretary, . | \$5,000 | No. 45 (consecutive) . | \$767 |
| “ assistant secretary, . | 2,500 | “ 97, | 748 |
| Executive clerk, | 2,000 | “ 111, | 724 |
| Clerks, Class 4, | 1,800 | “ 85, | 720 |
| “ Class 3, | 1,600 | “ 112, | 702 |
| Door-keeper, | 1,400 | “ 87, | 700 |
| Engineer and fireman, | 1,000 | “ 104, | 692 |
| Watchman, | 900 | “ 75, | 680 |
| Messenger, | 840 | “ 1, | 675 |
| Packer, | 720 | “ 110, | 668 |
| Carpenter's helper, | 660 | “ 23, | 667 |
| Watchman, | 540 | “ 49, | 660 |
| Coal passer, | 500 | “ 32, | 654 |
| Laborer, | 480 | “ 50, | 650 |
| Charwoman, | 240 | “ 25, | 648 |

Although the column of wages is compiled from private budgets, it undoubtedly contains some estimates, and these aid in accounting for the round numbers appearing in it.

Many of our state bureaus of labor have attempted to collect material from the private account books of workmen, to show their actual income from all sources, and their expenditures. In such inquiries the tendency toward round-numbered estimates has constantly to be met. To illustrate: An unskilled painter reports to the Maine Bureau of Labor that his yearly earnings are \$490. Of this he reports \$100 as spent for rent, which means that his monthly rent was \$8.33. He reports \$200 spent in food, \$100 in clothing, and \$42 for fuel and light, which, together with \$58 for miscellaneous expenditures, makes another even hundred. Thus his total expenditures foot up neatly to \$500, leaving him exactly \$10 behind on the year.‡ Such returns must be set down at once as estimates. The study of private budgets is blocked by those who in this manner return estimates rather than take the trouble to keep an exact memorandum of expenses and income.

A very large number of budgets of expenditure and income for workingwomen of Chicago is given in the *Seventh*

* *Estimates of Appropriations*, 1895-96, pp. 16, 17, 19, 23, 41.

† *Report of Maine Bureau of Labor*, 1891, pp. 94-107.

‡ *Report of Maine Bureau of Labor*, 1891, pp. 34, 35.

Annual Report of the Illinois Bureau of Labor Statistics.

Turning to Table V, if we select the reports of employees of department stores as fairly typical, we have 142 budgets that can be studied. Noting the round numbers in the various items reported, we can tabulate our observations as follows:—

ITEMS REPORTED.

| | Earnings. | | Expenditures. | | Savings.* | | Board and Room. | | Clothing. | |
|-----------------------------|-----------|-----------|---------------|-----------|-----------|-----------|-----------------|-----------|-----------|-----------|
| | No. | Per Cent. | No. | Per Cent. | No. | Per Cent. | No. | Per Cent. | No. | Per Cent. |
| Total Number of Reports.... | 142 | 100.00 | 142 | 100.00 | 27 | 100.00 | 90 | 100.00 | 141 | 100.00 |
| Divisible by 5.. | 54 | 38.00 | 50 | 35.21 | 17 | 62.96 | 39 | 43.33 | 125 | 88.65 |
| Divisible by 10 | 38 | 26.76 | 35 | 24.65 | 13 | 48.14 | 28 | 31.11 | 72 | 51.06 |
| Divisible by 25 | 19 | 13.38 | 18 | 12.68 | 7 | 25.96 | 5 | 5.55 | 60 | 42.55 |
| Divisible by 100 | 10 | 7.04 | 9 | 6.34 | 2 | 7.41 | 2 | 2.22 | 22 | 15.60 |

| | Assistance to Others. | | Sickness. | | Car Fare. | | Dress Making. | | Other. | |
|-----------------------------|-----------------------|-----------|-----------|-----------|-----------|-----------|---------------|-----------|--------|-----------|
| | No. | Per Cent. | No. | Per Cent. | No. | Per Cent. | No. | Per Cent. | No. | Per Cent. |
| Total Number of Reports.... | 105 | 100.00 | 52 | 100.00 | 136 | 100.00 | 127 | 100.00 | 140 | 100.00 |
| Divisible by 5.. | 31 | 29.52 | 20 | 38.46 | 42 | 30.88 | 77 | 60.63 | 105 | 75.00 |
| Divisible by 10 | 21 | 20.00 | 8 | 15.38 | 30 | 22.06 | 45 | 35.43 | 53 | 37.86 |
| Divisible by 25 | 5 | 4.76 | 5 | 9.61 | 2 | 1.47 | 15 | 11.81 | 14 | 10.00 |
| Divisible by 100 | 2 | 1.90 | | | ... | | | | | |

The average figures for each class of entry are as follows:—

| | | | |
|-------------------------|----------|---------------------------|----------|
| Earnings, | \$329.00 | Assistance to others, . . | \$164.00 |
| Expenditures, | 313.00 | Sickness, | 15.00 |
| Savings, | 16.00 | Car-fare, | 28.00 |
| Board and Room, . . . | 187.00 | Dress-making, | 16.00 |
| Clothing, | 71.00 | Other expenditures, . . | 20.00 |

These averages are given chiefly to point out that, in considering the occurrence of numbers divisible by 25 and 100 in these reports, we must recollect that many entries are too small to be divisible by such numbers. It will be seen that these averages give a false color of accuracy—a point noted earlier in the paper.

* These deficits are reported, one of \$15, one of \$9.00, and one of \$7.00.

If we were to attempt to estimate a man's yearly income from his daily or weekly wages, it would be necessary to know the number of days or weeks that he was out of work. The subject of unemployment is accordingly one which has occupied an important position in the investigations of labor bureaus. For information they are compelled, however, to rely mainly upon the statements of the workmen themselves. Let us see how estimates affect us here and how they can be detected by round numbers. The New Hampshire Bureau of Labor, in its *Second Annual Report*, 1894 (pages 384, 385), prints the reports of New Hampshire workmen as to the length of time they were idle during 1894. The reports are distributed as follows: —

| Idle Weeks. | Number Reporting. | Idle Weeks. | Number Reporting. | Idle Weeks. | Number Reporting. | Idle Weeks. | Number Reporting. |
|-------------|-------------------|-------------|-------------------|-------------|-------------------|-------------|-------------------|
| 1 | 16 | 11 | 5 | 21 | 1 | 31 | 0 |
| 2 | 60 | 12 | 23 | 22 | 2 | 32 | 0 |
| 3 | 28 | 13 | 8 | 23 | 0 | 33 | 4 |
| 4 | 13 | 14 | 6 | 24 | 0 | 34 | 0 |
| 5 | 37 | 15 | 21 | 25 | 33 | 35 | 2 |
| 6 | 15 | 16 | 6 | 26 | 0 | 36 | 1 |
| 7 | 21 | 17 | 43 | 27 | 4 | 37 | 0 |
| 8 | 28 | 18 | 1 | 28 | 0 | 38 | 1 |
| 9 | 10 | 19 | 0 | 29 | 2 | 39 | 0 |
| 10 | 36 | 20 | 15 | 30 | 3 | 40 | 0 |

The total number of persons reporting is 443. It will be seen by inspecting these columns of figures that a much larger number of men report having been idle five weeks than report four or six weeks. A much larger number report ten weeks than report nine or eleven. This betrays the fact that many of the returns are estimates. The number of persons reporting eight weeks undoubtedly includes some who estimated two months and counted it as eight weeks. At seventeen weeks we encounter a very large number of reports that seem to form an exception. Here we have undoubtedly some such a calculation as this: "Idle four

months" (estimated). To reduce this to weeks, multiply 4 by 30 and divide the 120 by 7, giving as the result $17\frac{1}{7}$. The record is placed at seventeen weeks. Some of the reports of twenty-five weeks doubtless represent an estimate of six months' idle time, and some of thirty weeks mean two-thirds of a year. Excepting these numbers that have been explained, it will be readily seen that the most prominent peculiarity of the reports is their cumulation on 5 and its multiples, 15, 20, 25, 30, and 35.*

If we turn our attention very briefly to prices, keeping in view mainly the expenditures of such wage-earners as we have been considering, we shall see another and an equally important side of this subject. The meaning of a given wage depends upon its power to purchase those articles which constitute the necessities of life, and its power to reach up into comforts and luxuries. If we examine the expenditures of wage-earners we find that they are very greatly influenced by the occurrence of round numbers in retail prices. The round numbers of prices ought, however, not to be confused with the round numbers that occur in estimates of expenditures which were discussed on a preceding page.

Throughout the consideration of this subject we ought not to forget that in all probability the use of round numbers works, in the majority of instances, to the detriment of the wage-earning classes. When just compensations fall between two convenient round numbers, if it is a case between the employer and the employee for wages, or between the landlord and tenant for rent, or between the merchant and customer (especially the credit customer) for food or clothing, the latter party in each case will usually be the one forced to give way, and the round number most favorable to the stronger of the two bargainers will be chosen. The higher rather than the lower unit will be forced upon the workman in expenditures, and the lower rather than the higher in

* An interesting parallel to these figures can be seen on pages 378, 379 of the report here referred to.

income. This margin of convenience, if we may so call it, when always exacted from one party, is by no means an insignificant matter.

Let us consider, first, expenditures for rent. The *Tenth Annual Report of the Michigan Bureau of Labor* (1893) tabulates on pages 788 and 789 the rent paid by 13,719 Michigan workmen. The rents paid and the numbers reporting each rent are given, as follows:—

| Rent. | Number Reporting. | Rent. | Number Reporting. | Rent. | Number Reporting. | Rent. | Number Reporting. |
|--------|-------------------|--------|-------------------|--------|-------------------|---------|-------------------|
| \$1.00 | 42 | \$4.00 | 191 | \$6.75 | 2 | \$10.75 | 1 |
| 1.50 | 1 | 4.25 | 7 | 7.00 | 506 | 11.00 | 138 |
| 2.00 | 11 | 4.50 | 33 | 7.50 | 29 | 11.50 | 7 |
| 2.25 | 1 | 5.00 | 520 | 8.00 | 744 | 12.00 | 343 |
| 2.50 | 44 | 5.25 | 1 | 8.50 | 11 | 12.50 | 3 |
| 2.75 | 3 | 5.50 | 22 | 8.67 | 1 | 13.00 | 189 |
| 3.00 | 98 | 5.75 | 1 | 9.00 | 268 | 13.50 | 1 |
| 3.25 | 8 | 6.00 | 577 | 9.50 | 3 | 13.75 | 2 |
| 3.50 | 56 | 6.25 | 2 | 10.00 | 565 | 14.00 | 101 |
| 3.75 | 5 | 6.50 | 17 | 10.50 | 2 | 15.00 | 23 |

It will be noticed that the rents expressed in even dollars are decidedly in the majority. Thus 506 persons report a rent of \$7.00 per month, and 744 persons report \$8.00, while but 29 persons report \$7.50. But one rent breaks into the division of the quarter of a dollar, and this is \$8.666, which comes out even dollars if payment of rent is made quarterly or yearly. The rents in which a half-dollar occurs are as much more popular than those with twenty-five cents or seventy-five cents, as rents in even dollars are more popular than all others. Eight dollars is the most popular rent figure, and the number of reports declines as the rent varies from this amount. Against the decline, however, \$6.00 and \$5.00 hold out below, and \$10 and \$12 hold out above eight dollars. Reports similar to these can be found in other parts of the volume above mentioned.

These figures show that landlords are students enough of human nature to know that if the rent of a house ought to be

about nine dollars per month they can as easily get ten dollars. They show that if a rent ought to be any given number of dollars, plus a half-dollar, an additional half-dollar can as easily be obtained, making the price of rent even dollars. Probably, if a rent were left with a half-dollar appearing in it, the ordinary tenant would be dissatisfied, and an attempt would be made to get it thrown off, while there would be no thought of getting a half-dollar taken from a rent expressed in even dollars. Besides this, the figures just given show an inability to determine accurately what rent should be; hence estimates, drifting as usual to common and typical figures, are to be found in the reports.

In following the expenditures of a workman's budget let us turn to lines where the distinction of wholesale and retail exists. As the record of wholesale and retail prices is not easily ascertained for places in the United States, let us, for convenience, take up German statistics. Only a few of the more striking examples can be drawn upon in illustrating our point. The characteristic differences between wholesale and retail prices are illustrated by the records of wholesale and retail prices of rye flour for the months of 1891 and 1892 for the city of Berlin.*

WHOLESALE PRICE OF RYE FLOUR, BERLIN, PRUSSIA, BY MONTHS.
Price, per 10 Kilograms (22.046 Pounds), in Marks.

| | 1891. | 1892. | | 1891. | 1892. |
|---------------|-------|-------|----------------|-------|-------|
| January..... | 1.72 | 3.02 | July..... | 2.14 | 2.52 |
| February..... | 1.72 | 2.92 | August..... | 2.33 | 2.00 |
| March..... | 1.77 | 2.91 | September..... | 2.26 | 1.97 |
| April..... | 1.84 | 2.68 | October..... | 2.31 | 1.91 |
| May..... | 1.99 | 2.63 | November..... | 2.36 | 1.80 |
| June..... | 2.09 | 2.62 | December..... | 2.35 | 1.74 |

Retail price was 3.30 in January; 3.40, February to July, inclusive; 3.70, August to December; 3.60, January, 1892; 3.50, February; 3.30, March to November, inclusive; 3.00, December.

* *Statistisches Jahrbuch für deutsche Städte*, 1893, pp. 136-147.

The wholesale price would be indicated by a broken record line, the retail price by a continuous line. The wholesale price is variable, fluctuating in response to every influence on the market. It makes both infinitesimal and large variations, and does so at irregular intervals. It shows no conformity to round numbers or to convenient methods of calculation. It may be said to coast close to the actual cost of production, yielding at the slightest pressure from any direction and changing with the nervous sensitiveness of fear as the forecasts of the market change. The retail price, on the other hand, seems to move according to an altogether different law. It strikes boldly out, and lays between itself and the wholesale price a good round margin. It moves in a more mechanical way than does the wholesale price, and responds slowly to change, seeking convenient round numbers and clinging persistently to ascertained price levels. When it does change it shows evidence of having broken through strong restraints, — through a “cake of custom,” perhaps, — for it makes leaps of considerable distance in a short period. While the wholesale price, in the period we have considered, registers twenty-four different monthly levels, the retail price registers but six.

If we place side by side the monthly averages of the wholesale and retail price of beef for the city of Strassburg in 1891, we shall note some of the same differences before observed.* The prices given in marks per kilogram, and representing in retail trade second choice of meat, are as follows: —

| Wholesale. | Retail. | Wholesale. | Retail. |
|------------|---------|------------|---------|
| 1.186 | 1.35 | 1.224 | 1.20 |
| 1.14 | 1.36 | 1.22 | 1.20 |
| 1.122 | 1.32 | 1.2125 | 1.20 |
| 1.155 | 1.28 | 1.22 | 1.20 |
| 1.152 | 1.26 | 1.205 | 1.20 |
| 1.2275 | 1.20 | 1.194 | 1.20 |

* *Statistisches Jahrbuch für deutsche Städte*, vol. III, pp. 138, 139, 141, 144.

The average monthly price of wheat per kilogram, whole-sale, and of flour, retail, for Hannover in 1891 gives us much the same results. The prices in marks are : —

| Wheat (Wholesale). | Flour (Retail). | Wheat (Wholesale). | Flour (Retail). |
|--------------------|-----------------|--------------------|-----------------|
| 0.185 | 0.32 | .228 | .40 |
| .186 | .32 | .236 | .40 |
| .193 | .36 | .231 | .40 |
| .213 | .36 | .228 | .40 |
| .236 | .40 | .236 | .40 |
| .235 | .40 | .235 | .40 |

Although in this article we consider wholesale prices as relatively exact, it is not hard to find indications that even into them there enter many estimated factors. The demand for a certain class of goods has an influence upon the whole-sale price ; and when the demand is subject to fluctuation, or when articles are put upon the market for the first time, the extent of the demand must be an estimated factor. If we study the various elements of expense entering into the cost of an article, we shall find that, despite the admirable systematization of business and the usual precision of book-keeping, few men can say exactly what proportion of the expense of an establishment a given piece of goods ought to bear, under the existing conditions of trade. The principle of charging “what the traffic will bear” must then be constantly recognized in fixing wholesale prices, and this is a process of estimation.

One of the important factors entering into wholesale prices we should readily admit to be payment of interest for capital invested in a business. The *Second Annual Report of the Montana Bureau of Agriculture, Labor, and Industry*, issued in 1894, gives in one part of its statistics the estimates of 163 business men as to the amount of the capital they have invested in their businesses. One capital occupies 7 decimal places and has ciphers in the first 5 places. Two capitals occupy 6 places and have 5 ciphers each. Seventy-three

capitals occupy 5 places and 31 have 4 ciphers; forty-one have 3 ciphers, and one has no cipher. Eighty-five capitals occupy 4 places and sixty-nine have 3 ciphers, while sixteen have 2 ciphers. Two capitals occupy 3 places and both have 2 ciphers. In the same report are to be found figures representing the payments for labor made by the same business concerns. These are somewhat more exact, but do not differ greatly in character from the above. The value of the product is given also, and these figures are only a shade more exact than those for capital. If these, then, be some of the elements which enter into wholesale prices, and the most determinate elements at that, and if we frequently find them to be estimates, what can we expect from wholesale prices in the way of accuracy? Undoubtedly we must make allowance for the fact that, while bureaus of labor can often obtain only estimates, business men who return these have more exact figures accessible for their own use and guidance.

Turning again to retail trade, we find that in it competition often exerts little or no effect upon prices. Competition may rather sometimes result in the division of trade among a number of dealers, each maintaining prices, or perhaps joining in an upward tendency of prices. In centres where public markets are maintained competition has often the effect of bringing retail prices to resemble wholesale. The estimated prices placed on goods then disappear and give place to those in which the retailer has accurately computed his expense and margin of profits. Retailers then rather resemble jobbers, who figure commissions, than typical retail dealers.

The difference between a large and small market, in the matter of estimates and in the calculation of margins, is a striking one. This difference can be seen by comparing the figures for the average monthly price of beef per kilogram in Berlin with the price of the same article in Potsdam, an aristocratic suburb.

| | Berlin. (Price in Marks.) | Potsdam. |
|--|------------------------------|----------|
| | 1.34 | 1.40 |
| | 1.30 | 1.40 |
| | 1.28 | 1.40 |
| | 1.29 | 1.40 |
| | 1.28 | 1.40 |
| | 1.27 | 1.40 |
| | 1.30 | 1.40 |
| | 1.30 | 1.40 |
| | 1.28 | 1.40 |
| | 1.28 | 1.40 |
| | 1.28 | 1.40 |
| | 1.28 | 1.40* |

* See previous reference.

Let us examine into the difference between retail markets in a portion of our own country by means of a comparison of certain prices at Antigo, Wis., with the prices of the same articles on the same dates at Racine, Wis.

The price of corn in Antigo, January 1st to May 21st, was 40 cents; from June 18th to December 3d, 38½ cents. The price of corn in Racine on successive dates was 49, 50, 45, 63, 71, 63½, 53, 55½, 61½, 63½, 52, 53, and 46½ cents, showing more numerous fluctuations.

Wheat in Antigo from January 1st to February 26th was 80 cents; March 26th to July 16th, 90 cents; August 13th to December 3d, 80 cents. The price of wheat in Racine, however, varied as follows:—

| | | | |
|---------------------|--------|----------------------|--------|
| January, | \$0.82 | July, | \$0.90 |
| February, | .90 | August, | 1.00 |
| March, | .92 | September, | .90 |
| April, | 1.05 | October, | .90 |
| May, | .92 | November, | .90 |
| June, | .95 | December, | .90 |

The price of beans in Antigo from January 1st to February 26th was \$2.25; and from March 26th to December 3d, \$2.87½. The price of beans in Racine showed the following changes:—

| | | |
|--------|--------|---------|
| \$2.35 | \$3.25 | \$1.87½ |
| 2.25 | 2.85 | 1.57½ |
| 2.27½ | 2.90 | 1.70 |
| 1.90 | 1.67½ | |
| 2.30 | 1.95 | |

Antigo is a place of about 5000 inhabitants, located in the northern part of Wisconsin, in a newly-opened region. Its products are lumber and furniture. It ships in a portion of its food supply large enough to materially affect the price. It has but a single line of railway, and is near no waterway or large market. Racine is a city of over 20,000 inhabitants, situated on Lake Michigan, but a short distance from Chicago, with which it is connected by rail as well as by waterway. The Chicago markets govern the prices of Racine. It will be readily seen, upon consulting these figures, that the prices of Antigo are typically retail, while those of Racine present numerous fluctuations, and in general exhibit the characteristics of wholesale prices.*

If space would permit it would be possible to show that large retail establishments in the centre of a large city approximate much nearer to wholesale prices than do small stores in residence quarters. The different regions of a country, indeed of a single city, might be plotted into different price areas if complete statistics were available. The indications are that such a map would show that competition is sadly distorted and often almost ineffective in retail trade. The retail system often works a nuisance by its lack of response to prevailing market conditions, and by failing to properly co-ordinate price and service. Retail trade, in a small way, is easy to enter. It is therefore frequently overloaded by those who attempt, by putting a wide margin on prices, to support themselves from a small patronage, depending upon local convenience. Since the marking of goods is for such dealers a sort of guess-work, prices display round numbers.

The mental inertia which causes customers to remember only certain commonly used quantities and values, and to carry away only general impressions, accounts for the at-

* For these figures I am indebted to Mr. W. C. Norton, a member of the class in statistics at the University of Wisconsin, who compiled them from newspaper files.

tempts of tradesmen to put a price in such figures that it will be thought of in connection with the lowest possible common price unit. To illustrate: We have 99-cent prices and 49-cent prices. That such prices exist proves the mental processes of the average customer to be imperfect, for it shows that a price can be suggested which is nine units lower than the actual price, before one is suggested which is one unit higher.

The instinctive demand of the average mind for customary conditions, in which it can feel safe, leads to numerous expedients on the part of producers and retailers to maintain fixed prices. A common practice, in case an article has enhanced in value, is to retain the well-known price, but slightly change the quality of the article. Many buyers trust so implicitly to price as a criterion of value, that great frauds in adulteration become possible. To say that an article was bought at So-and-so's establishment is thought by many people, even those capable of discriminating as to quality, to be worth an addition of 25 per cent in price. If a change of apparent price is to be avoided, another way sometimes employed is to bring out an article in a different stage of completeness than that in which it was previously offered. This makes it possible to slip in an amount sufficient to cover enhanced values while the cost of further preparation is being added. Although the price of meat fluctuates considerably in Germany, the prices of well-known makes of sausage remain practically stable. The varying slack or tension of competition is usually taken up by retail trade, which thus affords the customer convenient and customary prices.

The power of the inertia of the customer is one which manifests itself in innumerable ways. The study of the consumer and of the retail market ought to supplement the study of the producer and of the wholesale market in political economy. The small transactions, daily and sometimes hourly repeated by the mass of the people, have peculiarities

attached to them which are interesting alike for the psychologist, the economist, and the statistician. It is difficult to find tables of statistics into which estimated factors have not at many points entered. The value of these statistics cannot therefore be completely determined until we understand the peculiarities of social practice in the use of estimates.

Remarks by James P. Munroe.

It seems to me that Dr. Jones puts too much faith, by implication, in the accuracy of reported wholesale prices. It is true that they are far more sensitive than retail prices, and what may be called raw materials — food stuffs, hides, wool, etc. — seem to respond very quickly to the expansion and contraction of the market. But into market prices and reported cost prices of *manufactured* goods the “round-number tendency” enters, I think, more fully than he appears to believe.

Dr. Jones will doubtless agree that there are, roughly speaking, four classes of manufacturers, — those who know first costs and are honest; those who are honest and do not know first costs; those who know but do not care, so long as they can find some one to trust them; and, finally, those who neither know nor care. With the fourth class statisticians have little to do; but so easy are credits, and so sanguine are investors, that the second and third classes, often for considerable periods of time, dictate the selling price of many manufactured articles. Yet it is obvious that such selling prices have no place in accurate statistics, and might seriously vitiate conclusions derived from them.

But even were it possible to throw out such abnormal selling prices and the cost prices that by the usual percentage calculations would be derived from them, so that we should deal statistically with the figures of those manufacturers only who both know and care, we would still be hampered by the wholly concealed presence of many “round-number” estimates in figures that by their fractional character are deceptively accurate in appearance.

In fixing selling price the manufacturer must take into account the cost of what to him is raw material, of labor, of fuel, of “wear and

tear," of handling, and perhaps of storage, in addition to the fixed charges of interest, taxes, office expenses, etc., and other minor and fluctuating charges peculiar to each manufacture. His figures for labor cost and fixed charges will be pretty accurate; the first because they can be taken directly from his pay-rolls, and the second (except in a newly established business) because they are generally the average of a fairly uniform experience during a number of years. But the cost of raw material, often the largest item of cost, cannot be exactly determined, since it fluctuates (and the more "raw" the material the greater its fluctuation); since it cannot be bought in great quantity at a period of low prices without adding a large storage and interest charge; and since it, in turn, is subject to the same (or greater) uncertainties in its cost of production. So in calculating his cost price the manufacturer strikes an average somewhere between the highest and lowest prices that his raw materials are likely to reach, and, unless it should be too far away from the figure that his judgment approves, this average cost of raw materials will be a round number. The same result will appear in the case of fuel (or water power) and in many of the smaller items of fluctuating cost that must enter into his calculation. Therefore, I think, in the case of the usual honestly figured and faithfully reported "cost price," we are dealing with a hybrid figure made up of a minutely calculated labor and fixed-charge cost, and an estimated raw material cost, that may never once during the year express the actual cost. A further vitiation will often enter through the fact that the manufacturer, upon "feeling" the market and finding that he must "shade" a little, or can safely "raise" a little, is often inclined to review his estimates, with the result of depressing or elevating his "cost price" to the nearest round number. A final source of error to the statistician is to be found in the fact that he gets, as a rule, *past* figures, when these original errors in cost price per pound or per yard have been multiplied by hundreds of thousands, and this large sum has been divided by the "average yearly production" or some other *estimated* figure, giving a new "cost price," that by its fractional quality appears more accurate than would have seemed the original and much closer "round number" estimate.

Remarks by Prof. W. F. Willcox.

Perfect accuracy of measurement is an ideal unattained in any field. Where accuracy stops, and it always stops at last, round numbers begin. The term may be miles or millimeters, centuries or thousandths of a second, but as nature offers us a continuum, and we measure it by steps, the end is ever the same. The physical sciences have removed it to a remote distance, but they always reach it. Accuracy of measurement depends upon the number of steps that are introduced into the scale, and this upon the education of the persons using the scale and the employment of instruments of precision. Hence, in social phenomena, where the entire public must use the scale, and where instruments of precision have slight application, the scale must be a short one. One of the prime advantages of a money economy over barter is that it lengthens the scale, and so increases the accuracy of social measurements.

My attention has recently been called to the inaccuracies in the statements of age to which, in passing, Dr. Jones's paper calls attention. During the first twenty years of life there is a slight but traceable tendency to concentrate on the even years, and minima, rather than maxima, are found at five and fifteen. But after twenty the predominant tendency is to concentrate on the multiples of five with a minor but perceptible tendency to emphasize the multiples of two. Hence, the greatest concentration occurs at the multiples of ten, a less on the odd multiples of five, and the least on those multiples of two, *e. g.*, 28, 32, 38, 42, etc., which are not next to a five-year maximum. This tendency to concentrate on certain years may be roughly measured in the following manner: The true number of persons, say of thirty years of age, may be assumed to be one-fifth of the number reported, as 28, 29, 30, 31, or 32. If, from the number reported as 30, one-fifth of the sum be deducted, the remainder will represent approximately the number incorrectly reported as thirty. The percentage that this excess is of the whole sum may then be computed.

The foregoing method has been followed with the reported ages of the total population in 1880 and 1890, and its results are embodied in the table subjoined. Where no sign is printed, a + representing a maximum should be understood.

| Age. | Percentage of Concentration in :— | | Improvement in 1890. |
|------|-----------------------------------|-------|----------------------|
| | 1880. | 1890. | |
| 5 | — .02 | — .48 | — .46 |
| 10 | 1.24 | .97 | .27 |
| 15 | —1.37 | — .71 | .66 |
| 20 | .98 | — .05 | .93 |
| 25 | 2.48 | 1.02 | 1.46 |
| 30 | 9.44 | 7.05 | 2.39 |
| 35 | 8.33 | 5.09 | 3.24 |
| 40 | 13.45 | 9.11 | 4.34 |
| 45 | 10.25 | 7.81 | 2.44 |
| 50 | 12.70 | 10.91 | 1.79 |
| 55 | 5.67 | 3.10 | 2.57 |
| 60 | 15.94 | 12.98 | 2.96 |
| 65 | 8.27 | 6.37 | 1.90 |
| 70 | 11.55 | 10.31 | 1.24 |
| 75 | 6.22 | 5.08 | 1.14 |

The preceding table shows that at each five years of age after the first there was less concentration on the multiples of five at the last census than at the preceding. It may have been that with the progress of education a smaller proportion of the population had to guess at their ages, or that in the matter of ascertaining the actual age the enumerators worked with more care, or both. If the enumerators in 1890 were more careful to secure the exact age, as seems probable, it might furnish a reason for believing that in other respects also the Eleventh Census was taken more carefully than the Tenth. But doubt is cast upon the inference by finding that the "Instructions" issued to enumerators in 1880 said: "The exact age will be inserted whenever the same can be obtained; otherwise the nearest approximation thereto," while the "Instructions" issued in 1890 were much more specific: "The *exact* years of age for all persons one year old or over should be given whenever it can be obtained. In any event do not accept the answer 'don't know,' but ascertain as nearly as possible the approximate age of each person. . . . If the age is given as 'about 25,' determine if possible whether the age should be entered as 24, 25, or 26. Particular attention should be paid to this." Granting the greater care of the enumerators in this regard, it would not argue, therefore, that in subjects about which no difference between the instructions can be found they

were also more careful. The topic is worthy of further study, for not only may different censuses thus be compared, but also different states and cities and social classes about which the facts may be reported.

Remarks by Horace G. Wadlin.

Prof. Jones's interesting paper groups a series of examples that very forcibly illustrate the tendency to use round numbers, not only in fixing wages and prices, but in various other operations. His first table, relating to ages of women in industry, brings out the well-known concentration upon quinquennial periods which is always noted in every census of ages. For example, in 1885, in Massachusetts, the returns of the enumeration indicated 38,659 persons of age 20, while the numbers of ages 19 and 21 were 38,406 and 36,438, respectively. Again, 44,087 were reported as of age 25, while the numbers at ages 24 and 26 were 42,475 and 37,950, respectively. This concentration upon the "round" quinquennial periods is not due to estimating, however, so much as to the apparently natural tendency in making reply to the questions of the enumerators to select a round period, when the age of the person approximates it, rather than to rest upon an intermediate year. This error, so far as tables of ages are concerned, is partly counteracted by classifying the ages by periods, either decennial or quinquennial, thereby distributing the error over the entire number of years included within such periods.

Thus, in the Massachusetts Census of 1885, to which I again refer for the purpose of illustration, the population is classified by age periods 20 to 29, 30 to 39, etc., and in many computations based upon the census, these aggregates by age periods are used instead of the single-year figures.

As to the vitiation of data relative to wages and prices by the presence of round numbers in the tables, such round numbers apparently indicating estimates, it must, I think, be admitted that in nearly all statistical presentations there is an element of error. That is, almost all such presentations are approximate rather than absolute. And while every practical statistician is aware of this, and never relinquishes effort to diminish the amount of error, it is nevertheless true that such errors as are inherent in any particular line of statistics may be considered to have about the same weight at different periods and

in different places, so that the effect of such errors, being common to all the units considered, will be eliminated in comparisons based upon such units. To make this plain, I refer again to the tables of ages in which the particular error we are considering is especially manifest. If, for example, the general tendency operates to increase the number of persons reported of each quinquennial age period, and this tendency has substantially equal force in the Census of 1895 as in that of 1885, then comparisons showing percentages of increase or decrease of persons of age 20, 25, or any other decennial period, or any deductions based on such comparisons, will not be materially affected by the error. It is the comparative use of statistics which is perhaps most common, and which is usually of largest practical utility.

The misconception due to the use of round numbers does not appear to me to be at all commensurate with that due to the use of averages, which, especially as to wages and prices, are likely to be extremely misleading. Nevertheless, averages certainly have their place in statistical presentations, and are entirely legitimate when the elements upon which they are based are alike; while averages based upon dissimilar units, secured at a given time and place, may be legitimately compared with averages dissimilar to each other, but based upon units identical with those from which the first average was derived, secured at a subsequent time, or at a different place, and the difference in conditions observed in such comparisons may be accepted as accurately determined. That is, *the amount of error in each term of the comparison is equalized*. Of course, as to wages of groups of workmen, the error due to concentration upon round figures in individual cases may be largely neutralized by a classification, similar to that to which I have referred respecting ages, whereby all receiving, for example, under \$5.00 weekly, \$5.00 but under \$6.00, \$6.00 but under \$7.00, etc., are grouped. And in many uses which are made of wage data such classifications are just as valuable as averages or individual figures, and much more exact than either.

Of course, data as to wages and prices should be as free as possible from estimates. It is not necessary in original investigation of these subjects to rely upon estimates. In an investigation conducted by the Massachusetts Bureau in 1883, wherein a very large number of quotations appear, the collection was made directly from the pay-rolls of great manufacturing establishments, or from the original wage-lists agreed upon between trade societies and employers. The same

method was followed in the collection of data in the well-known investigation undertaken by Senator Aldrich's committee in 1892.

Round numbers appear in the results of each of these investigations, but their presence is due to the fact, emphasized by Professor Jones, that, in establishing the wage or price, a round figure is evidently much more convenient in practical use; that is, the round wage or price, wherever it appears, represents the exact wage or price paid,—not an estimate made by those who collected the data. Wherever this is the case the statistical tables are not inaccurate, although round figures appear in them. As to the economic loss to the weaker party, either workman or consumer, involved in the fixing of wages or retail prices at round figures, this, as Professor Jones points out, may occur. But apparently no method has yet been determined of fixing either wages or prices at the exact point of equivalency of service or of cost of production, and it would seem impossible to thus fix them, apart from the general error due to the use of round numbers.

Remarks by Roland P. Falkner.

Round numbers, Dr. Jones shows, are of frequent occurrence in statistical tables. They may result from inaccuracy of statement, and therefore fail to properly represent the facts to be recorded, or on the other hand they may record an actual condition of affairs. Doubtless the same considerations are at work on both cases to produce the result. The same psychological tendency is observable in both, but in the one case it is mediate, in the other immediate. The two classes, while akin, should be rigidly separated by the statistician. In the first we have a psychological tendency affecting the statistical record and impairing its accuracy; in the second we have the same phenomenon affecting a given series of social or economic facts before it becomes the duty of the statistician to record them. These two cases may overlap and produce a third or mixed case, in which the psychological phenomenon which leads us to favor round numbers may affect not only the facts, but also the report which is made of them. In such a case we shall have a partially true but exaggerated distribution of the facts recorded.

In Dr. Jones's paper these three cases are not sufficiently distinguished. To the first class, where the tendency to round numbers is simply an expression of the inaccuracy of the evidence, belong the illustrations which give the age of women in Chicago industries, the household expenditures in Illinois, and the number of weeks unemployed of New Hampshire laborers. The conditions are here such that no one could pretend that any inherent tendency to round numbers could exist in the distribution of the facts themselves. On the other hand, a number of his illustrations which display the tendency to round numbers give a correct report of the facts. They are the salaries of government officers, retail meat prices in Strassburg, and retail flour prices in Hannover. It is possible that another illustration of the paper may belong to the third or mixed class. It is the statement of house rents in Michigan as reported by occupants. While there can be no doubt of the tendency on the part of landlords to fix rents in multiples of one dollar, it is also possible that the returns are affected by the natural tendency to express quantities in round numbers as approximately accurate. Much would depend upon the manner in which the figures were gathered, whether this latter element had weight.

In regard to the tendency toward round numbers which exists in the field of wages and prices, a veritable mine of information can be found in the Aldrich report on retail prices and wages. (Senate Report No. 936, First Session, Fifty-second Congress.) So far as I am aware, no analysis of the report from this point of view has been undertaken. It might be of interest, therefore, to examine the kind of material which it furnishes. The prices reported in the statement of retail prices were taken directly from the books, and represent actual facts. So far, therefore, as the figures show a tendency to round numbers, it is a tendency which rules in fixing retail prices, and is not merely an expression of greater or less accuracy in reporting them. In the following table the actual price quotations for earthenware articles in June, 1889, are summarized according as they are divisible by 5 and its multiples.

In each case the number of prices not divisible by 5 is a very small fraction of the total number of quotations. Considering the narrow limits within which the prices range, the number of quotations at \$1.00 or multiples thereof cannot fail to attract attention.

TABLE I.

RETAIL PRICE QUOTATIONS FOR EARTHENWARE ARTICLES IN JUNE, 1889.

Aldrich Report, Retail Prices and Wages, Vol. III, p. 1574, et seq.

| Divisible by — | Breakfast Plates, No. 7, ordinary printed, per doz. Range, \$0.70-\$3.00. | Breakfast Plates, No. 7, white granite, per doz. Range, \$0.50-\$1.50. | Covered Dish, ordinary printed, oval, 8 inches, each. Range, \$0.30-\$1.50. | Covered Dish, white granite, oval, 8 inches, each. Range, \$0.20-\$1.10. | Teacups and Saucers, ordinary printed, with handles, per doz. Range, \$0.75-\$2.25. | Teacups and Saucers, white granite, with handles, per doz. Range, \$0.40-\$2.00. | Total. Range, \$0.20-\$3.00. | Total Percentages. |
|------------------------|--|---|--|---|--|---|------------------------------|--------------------|
| 100..... | 32 | 56 | 31 | 12 | 22 | 38 | 191 | 20.85 |
| 50 and not 100..... | 20 | 4 | 10 | 20 | 44 | 11 | 109 | 11.90 |
| 25 and not preceding.. | 35 | 20 | 38 | 26 | 34 | 37 | 190 | 20.74 |
| 10 and not preceding.. | 50 | 55 | 35 | 46 | 39 | 61 | 286 | 31.22 |
| 5 and not preceding.. | 10 | 20 | 25 | 43 | 12 | 15 | 125 | 13.65 |
| None of preceding... | 2 | 4 | 5 | 2 | 0 | 2 | 15 | 1.64 |
| Total..... | 149 | 159 | 144 | 149 | 151 | 164 | 916 | 100.00 |

In the next group of articles to which the report relates a somewhat higher scale of prices prevails. In tabulating the facts for the prices of a bedroom set of furniture of antique oak, consisting of three pieces,—bedstead, bureau, and wash-stand, the prices of which range from \$100 to \$15,—it was not necessary to use the cents column, as in only two quotations was a fraction of a dollar recorded—namely, one-half dollar. In other groups the same tendency is observable. It is only in the food group, where purchases are frequent and the range of prices comparatively small, that numbers not divisible by 5 play any considerable rôle. Thus the report gives in June, 1889, 298 quotations for eggs. The range of price is from 7 cents to 35 cents per dozen. In 175 cases quotations are in multiples of 5. This leaves 123, or 41.27 per cent, expressed in uneven numbers.

The quotations for other low-priced articles of household use, which are less frequently purchased, do not show so many figures not divisible by 5. Thus, in tin cups, which range from 2 cents to 10 cents each, 134 quotations out of 186 were at 5 cents and 22 of the remainder at 10 cents.

The inertia of retail prices, which is alluded to in the article of Dr. Jones, is well illustrated by the figures of this report. The report gives not only the retail prices of commodities, but also the wholesale prices for the period in question. We may compare the course of prices not only for "all articles," but also for eggs and butter, which show a seasonal variation, and coffee-pots, dinner-pails, and tin cups, which were affected by the change in tariff rates introduced by the Tariff Act of 1890.

In the twenty-eight months recorded the calculations of relative prices are based upon the average prices of the first three months of the series. The range of variation of all articles is at retail from 99.36 to 101.46, while at wholesale it is from 99.73 to 116.52. Of course, in this average many articles are included, and fluctuations tend to compensate. But a similar observation can be made in the calculation for individual commodities. For eggs the variation ranges at retail from 97.65 to 155.86, and at wholesale from 99.32 to 192.08. An analogous variation can be observed in the figures of butter, of the two grades given in the tables. So far as articles constructed of tin are concerned, the rise in prices which uniformly takes place in the latter part of the period is greater in wholesale prices than it is in retail prices.

The peculiar merit of the illustrations which we have given lies in the extent to which the investigation was carried, and the conditions under which it was instituted, which give us the highest guaranty that the facts recorded are correctly reported. Instances of the phenomenon which Dr. Jones has so ably discussed might be drawn from a wide variety of sources. It is hoped that the evidence herewith presented may serve to show how wide this range is. We hold it, moreover, to be important to distinguish correctly between such irregularities in statistical statement as arise from inaccurate reports, and those which represent an actual distribution of facts.

Remarks by L. G. Powers.

I have been greatly interested in the paper of Dr. Jones. Round numbers meet the investigator of social phenomena everywhere. They do not prove the existence of a spirit that seeks to deceive; they do prove the fact that for the given case the party reporting does not conceive the subject of sufficient importance to take the

trouble to secure the exact facts for which he gives an estimate. The principle involved, leading to the use of an estimate where exact facts are supposed to be called for, can well be stated by a concrete case.

In the factory inspection department of the work of the Minnesota Bureau of Labor, accidents in factories are reported in accordance with a general provision of law. The law specifically requires certain information, such as the nature and extent of the injury and the circumstances attending the same. The blank return for accidents prepared by the Bureau also calls for the age of the injured. In the last four years 1289 accidents have been reported. They are quite full for most of the information called for by the statute. Most people see the use and value of such knowledge, and take great pains in reporting exact facts. But when they come to ages it is different. The employer reporting apprehends that the age is not an essential requisite of the report, and so, without taking great trouble, he estimates it as well as he can. In some cases he omits it altogether. Thus, out of the 1289, 425 did not have the age given. Of the others, the ages of those under 16 or 17 are given with reasonable exactness. The operation of the child-labor acts and kindred factors assists in furnishing the employer with the data at hand for exact information. But as we pass upward from 17 it is quite different. The farther we go until the age of 60 is reached, the more evidence is found of the use of round numbers, or, in other words, of estimates. This may be seen by the following tabulation of the 825 reported accidents:—

| Age. | Number. | Age. | Number. | Age. | Number. | Age. | Number. |
|------|---------|------|-----------|------|-----------|------|-----------|
| 12 | 1 | 25 | 50 | 38 | 22 | 52 | 3 |
| 13 | 2 | 26 | 19 | 39 | 8 | 53 | 4 |
| 14 | 4 | 27 | 24 | 40 | 50 | 54 | 2 |
| 15 | 21 | 28 | 40 | 41 | 6 | 55 | 10 |
| 16 | 17 | 29 | 13 | 42 | 7 | 56 | 1 |
| 17 | 23 | 30 | 56 | 43 | 4 | 57 | 1 |
| 18 | 19 | 31 | 8 | 44 | 8 | 58 | 1 |
| 19 | 22 | 32 | 26 | 45 | 30 | 60 | 1 |
| 20 | 33 | 33 | 21 | 46 | 6 | 62 | 3 |
| 21 | 33 | 34 | 14 | 47 | 4 | 63 | 1 |
| 22 | 23 | 35 | 71 | 48 | 3 | 64 | 1 |
| 23 | 23 | 36 | 16 | 49 | 5 | .. | .. |
| 24 | 23 | 37 | 21 | 50 | 20 | .. | .. |

For the ordinary purposes of the Bureau of Labor, no attention is ever paid to these reports of ages. They are too indefinite, and partake too much of the nature of estimates. They are unreliable for specific years; they may, however, be made use of in a general way. Thus, if we combine the foregoing data by certain periods of years, the margin of error due to estimates is made quite small and may be disregarded. One such massing of the foregoing data is presented, to show how the error due to such estimates may sometimes be eliminated:—

| Ages of Persons. | Number of Accidents. | Ages of Persons. | Number of Accidents. |
|------------------|----------------------|------------------|----------------------|
| 11 to 15..... | 28 | 41 to 50..... | 93 |
| 16 to 20..... | 114 | 51 to 60..... | 23 |
| 21 to 30..... | 304 | Over 60..... | 5 |
| 31 to 40..... | 207 | Total..... | 824 |

When such reports as those referred to by Dr. Jones, with a liberal use of round numbers, can be condensed and used in a general manner, such as the foregoing, they may be relied upon to give fairly good results with only a small margin of probable error. When they cannot be thus massed, I individually have grave doubts concerning their value in the study of social phenomena.

Remarks by Mary Roberts Smith.

A curious illustration of the way in which round numbers may affect prices in retail trade is found in the use of the "nickel" (five-cent piece) and the absence of pennies in California. One cannot buy here a single stick of candy, slate pencil, pair of shoe strings, a single spool of twist, package of pins, an orange or an apple, or even a single postal card or postage stamp (except in large post offices), but must always take five cents' worth. Many small articles denominated "dress-findings" cost five cents apiece here, which in New York would cost only two or three; and in the same way, articles which should cost five cents are ten cents apiece, or two for fifteen. The small buyer is thus always at a disadvantage. That this is recognized to some extent is shown in the case of a grocery, where, if one buys less than five cents' worth, a lead pencil is thrown in for change. Bankers also, in this country, credit themselves with the cents in accounts.